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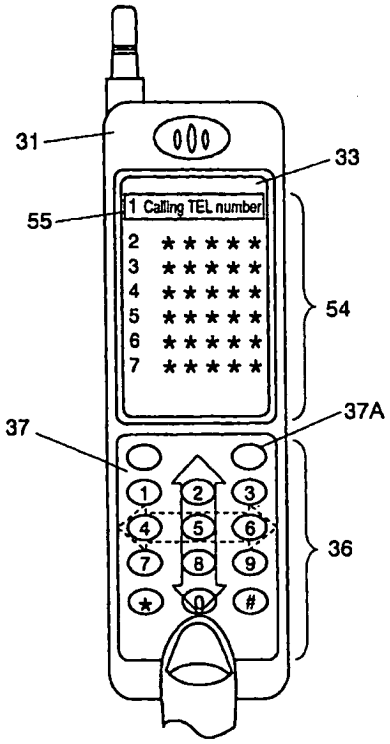
(54) Electronic apparatus

(57) In an electronic apparatus having a membrane switch and a touch panel switch at its entry section, the touch panel switch formed to be elastic is laid over the membrane switch. This two-layered structure provides users with two operations: a "finger-sliding" and a "finger-depressing." When a user slides the finger on the surface of the touch panel switch, the sliding force activates the touch panel switch. This "finger-sliding" is used for selecting a desired item. On the other hand, when the user depresses down on the surface of the touch panel switch, the depression force through the touch panel switch activates the underlying membrane switch. This "finger-depressing" is used for numeric or symbolic information entry. It is thus possible to realize an electronic apparatus offering an excellent compromise between an ease of operation and a wide display section.

FIG. 7



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Description

Field of the Invention

[0001] The present invention relates to an electronic apparatus, such as a video camera, an audio device and a mobile phone, having a plurality of entry switches arranged at its operating section.

Background of the Invention

[0002] With advances in digital techniques, consumer-oriented electronic products including mobile phones, video cameras, audio devices have been highly integrated, and endowed with high performance in their downsized bodies. Besides, the-state-of-the-art has also accelerates an improvement in the user interface including a display and a keyboard. Here, taking a mobile phone as an example of such conventional consumer-oriented electronic products, its structure and operating characteristics are described below.

[0003] First of all, the structure of a mobile phone is described with reference to the accompanying drawings. Fig. 11 is a front view of a conventional mobile phone. On the front side of outer housing 1, the sections, from top to bottom in the figure, arranged are:

(a) receiver 2 made of a loudspeaker;
(b) display 3 made of a LCD (liquid crystal display);
(c) touch panel switch 7;
(d) entry buttons made of numeric keys and confirmation keys;
(e) transmitter 5 made of a microphone.

[0004] Fig. 12 and Fig. 13 illustrate a cross-sectional view and an exploded perspective view of touch panel switch 7, respectively. As shown in the figures, conductive films 12 and 13, which are formed at face-to-face surfaces of touch panel switch 7, are sandwiched between properly shaped two insulating pads 10 and 11. Between conductive films 12 and 13, adhesive spacer 30 is inserted, keeping an interval in order to provide electric insulation. Insulating pad 10 is formed to be elastic. When a user's finger depresses or slides on the pad, the applied force recesses a position and leads to electric conduction between conductive films 12 and 13 into conduction. Each time the conduction is established, an output signal is obtained from electrode portion 14 via lead portions 15A to 15 D and 16. The structure adopted for touch panel switch 7 is generally called analog type or resistive film type.

[0005] As shown in Fig. 11, outer housing 1 accommodates expandable antenna 17 at its top. Display 3, touch panel switch 7, entry buttons 6, and electric circuitry (not shown) which controls antenna 17, are housed in outer housing 1. The structure including the electric circuitry is shown in the block diagram in Fig. 14.

[0006] In Fig. 14, Central Processing Unit (CPU) 18 performs various calculations and evaluations. More specifically, CPU 18 controls display 3 through Liquid Crystal Display (LCD) driver 19 and processes directly received signal from entry buttons 6; CPU 18 processes output signals from touch panel switch 7 via touch panel switch driver 20; CPU 18 controls antenna 17 via transmission-reception circuit 21; and CPU 18 also controls ROM 22 having pre-stored information, and RAM 23 in which the information items of telephone directory can be added or deleted as required.

[0007] The placing-a-call procedure is now described. Suppose that the phone number of a called party is selected by a search function from the phone numbers pre-stored in a memory in the mobile phone. When the mobile phone is not in communication, as shown in Fig. 15, display 3 displays initial menu 24 comprising a plurality of items, and cursor 25 pointing distinctively which item is currently selected in the menu.

[0008] In order to place a call with the search function, a user usually selects the "Calling telephone number" item in the initial menu. With the finger-sliding motion on the surface of touch panel switch 7, the user can put cursor 25 in display 3 on the "Calling telephone number" item. When the user slides the finger on the surface of insulating pad 10 formed to be elastic, a contact point between conductive films 12 and 13 changes its position, following the wake of the finger-sliding motion. Referring to now Fig. 13, lead portion 15 (15A through 15D) is extended from electrode portion 14 (14A through 14D). Lead portion 16 is electrically connected to conductive film 12 with contact portion 16A, which is laid beneath insulating pad 10. In responsive to the position changes by the finger motion on the surface, touch panel switch 7 produces an output signal (i.e., an output voltage value) with its magnitude varying between lead portions 15 and 16. Obtained from orthogonal two directions, the output signal is converted from analog to digital by touch panel switch driver 20. Then the converted signal is entered into CPU 18. Processing the received signal in time sequence, CPU 18 determines in which direction the finger slid on the touch pad surface of touch panel switch 7, and moves cursor 25 in a proper direction based on the determination.

[0009] With the cursor sitting on the desired item, the user depresses confirmation key 6A. Through this action, a decision signal is sent to CPU 18. The decision signal informs CPU 18 of completion of selecting and confirming the desired item. Receiving the decision signal, CPU 18 recognizes that the "Calling telephone number" item is selected, and fetches the pre-stored telephone directory information from RAM 23 or ROM 22. CPU 18 then sends the information to LCD 4 via LCD driver 19, so that the telephone directory appears on display 3.

[0010] With another finger-sliding motion on the touch pad surface of touch panel switch 7, the user now moves cursor 25 to point to a telephone number to be

selected, then depresses confirmation key 6A. In response to this action, CPU 18 recognizes that the selection is validated and performs the predetermined procedure: CPU 18 not only transmits a transmission signal through transmission-reception circuit 21 and antenna 17 to the selected phone number called party, but also activates receiver 2 and transmitter 5.

[0011] As described above, the finger-sliding motion on the touch panel surface of touch panel switch 7 is a quick-and-easy selection way in conventional mobile phones. The users can thereby pick out the desired item easily among many items on the display.

[0012] The ease of use mentioned above, however, is impaired on a smaller touch panel: the area requires enough space for the finger-sliding motion. Due to recent technological advances, electronic apparatus are getting smaller and smaller. On the other hand, the display area of such apparatus requires more space to cope with a higher volume of information to display thereon. In turn, it has become difficult to reserve an enough space for a touch pad in a limited space.

Summary of the Invention

[0013] The present invention addresses the problems discussed above and aims to provide an electronic apparatus without any space occupied exclusively by the touch panel switch on its entry section. It is a further object to provide an electronic apparatus that offers an improved finger-sliding operation with positive response to the touch panel switch.

[0014] In the structure of the entry section of an electronic apparatus according to the present invention, a touch panel switch with elasticity is placed over a depression switch with tactile feedback (similar to a clicking response.) The depression switch comprises a plurality of switch elements disposed in planar arrangement. When a user slides the finger on the surface of the touch panel switch structured above, an output signal from the touch panel switch changes responsive to the finger-sliding operation. From the output changes, the apparatus detects which direction the finger moves in and how far the finger moves on the touch panel. The detected moving direction and amount are associated with the items appearing on the display, so that the user can select a desired item and then enter it.

[0015] This two-layered structure thus offers users an user-friendly electronic apparatus having two ways in operation: the finger-sliding with a light touch enables to select a desired item; the finger-depressing with a force enough to activate the lower-layered depression switch enables to enter preset information including characters, numerals, and symbols.

[0016] According to the present invention, the apparatus comprises a display section displaying a plurality of items and pointing an item to be selected among the items, and a depression switch with tactile feedback. The depression switch is made up a plurality of switch elements and different information for data entry is assigned to each of them.

[0017] A touch panel switch formed to be elastic is laid over the depression switch with tactile feedback. Due to the elasticity, the force applied on the surface of the touch panel switch can also operate the lower-layered depression switch. When a user now slides the finger on the upper-layered touch panel switch, an output signal from the touch panel switch changes responsive to the finger-sliding operation. From the output changes, the apparatus detects which direction the finger moves in and how far the finger moves on the touch panel. The detected moving direction and amount are associated with the items appearing on the display, so that the user can select a desired item and then enter it. This two-layered structure not only eliminates the space allocated for a touch panel switch from the entry section, but also keeps an enough area for the finger-sliding operation easily. It is thus possible to provide an electronic apparatus with ease of operation.

[0018] In a preferred embodiment, a plurality of entry buttons may be arranged between the outer housing and the top surface of the touch panel switch. As the user's finger slides along the face of the arranged buttons, the bottom of the button depresses a specified position of the touch panel switch. That is, a staircase-shaped signal is obtained from the touch panel switch, which is reliable, easy to detect and control.

[0019] As another preferred embodiment, a transparent material may be employed for the touch panel switch and the entry buttons disposed thereon, and an illuminator disposed at beneath of the touch panel switch. The illuminator makes the surface of the touch panel switch glow for increased visibility, when the user operates the apparatus in the dark.

[0020] In still another preferred embodiment of the present invention, the apparatus comprises a display section displaying a plurality of items and pointing an item to be selected among the items, and an elastic membrane switch with tactile feedback. The membrane switch is made up a plurality of switch elements and different information for data entry is assigned to each of them.

[0021] The membrane switch is laid over the touch panel switch. As a user slides the finger horizontally along the surface of the membrane switch, an output from the touch panel switch changes responsive to the finger-sliding operation. From the output changes, the apparatus detects which direction the finger moves in and how far the finger moves on the membrane switch. The detected moving direction and amount are associated with the items appearing on the display, so that the user can select a desired item and then enter it. This two-layered structure thus not only eliminates the space allocated for a touch panel switch from the entry section, but also keeps an enough area for the finger-sliding operation easily. It is thus possible to provide an electronic apparatus with ease of operation. In addition, a

plurality of entry buttons may be disposed between the membrane switch and the outer housing laid thereon. This structure secures a positive depression on the membrane switch, providing users with a tactile response.

Brief Description of the Drawings

[0022]

Fig. 1 shows a front view of a mobile phone in accordance with a first preferred embodiment of the present invention.
Fig. 2 shows a side cross-sectional view of the mobile phone.
Fig. 3 is shows a partial enlarged cross-sectional view of a touch panel switch and a membrane switch, which are the essential parts of the mobile phone.
Fig. 4 shows an exploded perspective view of the touch panel switch, which is the essential part of the mobile phone.
Fig. 5 shows a block diagram of the mobile phone.
Fig. 6 shows a front view of the display section of the mobile phone before operation.
Fig. 7 shows a front view of the display section of the mobile phone in operation.
Fig. 8 shows a front view of a mobile phone in accordance with a second preferred embodiment of the present invention.
Fig. 9 shows a side cross-sectional view of the mobile phone.
Fig. 10 shows a side cross-sectional view of a mobile phone in accordance with a third preferred embodiment of the present invention.
Fig. 11 shows a front view of a conventional mobile phone.
Fig. 12 shows a cross-sectional view of a touch panel switch, which is the essential part of the conventional mobile phone.
Fig. 13 shows an exploded perspective view of the touch panel switch, which is the essential part of the conventional mobile phone.
Fig. 14 shows a block diagram of the conventional mobile phone.
Fig. 15 shows a front view of the periphery of the display section of the conventional mobile phone before operation.
Fig. 16 shows a front view of the display section of the conventional mobile phone in operation.

Description of the Preferred Embodiments

[0023] The preferred embodiments of the present invention are described hereinafter with reference to the accompanying drawings, Fig.1 through Fig.10.

First preferred embodiment

[0024] Fig. 1 shows a front view of a mobile phone in accordance with a first preferred embodiment of the present invention. In Fig. 1, outer housing 31 has a touch panel surface on the front, and is also an enclosure for accommodating electric circuitry therein. Above the touch panel surface, receiver 32 and display 33 formed by an LCD 34 are disposed, and disposed below the touch panel surface is transmitter 35. Fig. 2 and Fig. 3 show a cross-sectional view and a partial enlarged cross-sectional view, respectively. Entry section 36 is responsible for entry and selection when the mobile phone is in operation. As shown in Figs. 2 and 3, touch panel switch 37 formed to be elastic is arranged at the top surface of the entry section 36, and membrane switch with tactile feedback 38 is laid beneath of the touch panel switch 37. On the entry section side of the touch panel switch 37, as shown in Fig. 1, button markings 37A to 37N are arranged at the positions which correspond to each switch element of the membrane switch 38. Markings 37A to 37N indicate each position and function of each switch element.

[0025] When a user depresses some positions of the markings for numerical or symbol data entry, thanks to the two-layered structure described above, the depression on each position activates the corresponding switch element of the membrane switch 38. For example, when the user depresses marking 37C marked "1" (Fig. 1), the depression recesses, as shown in Fig. 3, the part beneath marking 37C in the elastic touch panel switch 37, further the force is transmitted through the touch panel switch 37 to conductive diaphragm 38A. If the depression force is beyond a predetermined value, conductive diaphragm 38A flips its shape vertically, thereby conducting the switch circuit having diaphragm 38A, which is formed on printed circuit board 38B. In this way, the numerical value, "1" is accepted as the entry data. For good tactile response and operability, the depression force, i.e., a repulsive force required to diaphragm 38A is preferably set to approx. 100-gram force (gf).

[0026] Touch panel switch 37 is generally called an analog type or a resistive film type. Figs. 3 and 4 illustrate a partial cross-sectional view and an exploded perspective view of touch panel switch 37, respectively. Conductive films 42 and 43 are formed on the face-to-face sides of rectangular insulating pads 40 and 41,respectively. Adhesive spacer 60 is inserted between conductive films 42 and 43 to keep an interval for electric insulation. This structure is the same as that in the prior art, with the exception that insulating pads 40, 41 and conductive films 42, 43 are all elastic.

[0027] On the periphery of conductive film 43 placed over insulating pad 41, four electrode portions 44 (44A through 44D) are disposed in the middle of each edge. Each electrode portion is sized shorter than the edges of the conductive film, and arranged in an

orthogonal orientation each other. Lead portions 45 (45A through 45D) are connected to each of electrode portions 44 (44A through 44D), respectively. Lead portions 46 are electrically connected to conductive film 42 laid beneath insulating pad 40 with contact portion 46A. As shown in Fig. 4, lead portions 45 and 46 are both extended out of touch panel switch 37.

[0028] In addition, touch panel switch 37 is arranged within outer housing 31 such that electrode potions 44A through 44D are placed in parallel with each edge of the touch pad surface and, the area surrounded by four electrode portions 44A through 44D works as the touch pad surface.

[0029] In order to obtain an output signal, touch panel switch 37 works the same manner as conventional type: the finger-sliding operation with a depression force on the surface of insulating pad 40 leads to electric conduction between conductive films 42 and 43. Touch panel switch 37 is adjusted so as to produce a predetermined output signal when a depression force of approx. 10 gf is applied.

[0030] According to the touch panel surface as described above, in which touch panel switch 37 is correctly associated with each element of membrane switch 38, and the depression force is adjusted to a predetermined value, when a relatively small depression force of approx. 10 gf is exerted on the surface of switch 37 by the finger-sliding operation, an output signal corresponding to the force can be obtained easily. On the other hand, when a positive downward depression force, for example, approx. 100 gf, is applied to one of markings 37A through 37N on touch panel switch 37, the switch 37 can transmit the force, due to its elasticity, to membrane switch 38. As a result, an output signal associated with the depressed marking position is now easily obtained.

[0031] In response to the depression force of 100 gf, touch panel switch 37 also reacts and produces an output signal. For avoiding a malfunction, it is preferable to employ a software-controlled evaluation such that any output signal from switch 37 is ignored when membrane switch 38 produces an output signal.

[0032] Referring now to Fig. 1, accommodating expandable antenna 47 at its top, outer housing 31 is the enclosure for display 33, touch panel switch 37, membrane switch 38, and electric circuitry (not shown in Figs. 1 and 2) for controlling antenna 47.

[0033] The structure including the electric circuitry of the mobile phone according to the preferred embodiment of the present invention is briefly described below. CPU 48, as shown in Fig. 5, executes a various kind of calculation and evaluation. As is similar to conventional structure, display 33, touch panel switch 37, membrane switch 38, and antenna 47 are coupled directly or via specific circuits to CPU 48: display 33, touch panel switch 37 and antenna 47 are coupled to CPU 48 via LCD driver 49, touch panel switch driver 50 and transmission-reception circuit 51, respectively, while membrane switch 38 is directly connected to CPU 48. CPU 48 also controls ROM 52 and RAM 53. ROM 52 holds pre-stored specific information therein, and ROM 53 allows users to add/delete telephone directory information as required.

[0034] Now described is about the operating principles of the mobile phone according to the preferred embodiment. Fig. 6 illustrates a mobile phone which is not in communication. Display 33, like the display in prior art, displays initial menu 54 comprising a plurality of items, and cursor 55 that highlights currently selected item among the items appearing on the display. In the conventional display, however, the structural limitation that an area for the touch panel has to be allocated between the display and the entry section inevitably "eats" the area for the display. When selecting a desired item from the initial menu with long lists, a user inconveniently scrolls hidden items to view. As opposed to the conventional design with such inconvenience, according to the embodiment, the structure in which touch panel switch 37 is laid over membrane switch 38 in Fig. 3 realizes a large display 33. Thanks to the two-layered structure, display 33 can display several lines of information items more than the conventional display can.

[0035] Here will be discussed how to place a call. In order to select a desired function from the initial menu, with the finger-sliding operation on the surface of touch panel switch 37, a user moves cursor 55 on display 33 toward a desired item. The depression force by the finger-sliding operation is relatively small, approx. 10 gf. In response to the force, touch panel switch 37 works as follows. Touch panel switch 37 comprises, as mentioned earlier, insulating pads 40, 41, and conductive films 42, 43. Conductive films 42 and 43 are formed on the facing surfaces of insulating pads 40 and 41, respectively. Two insulating pads are placed at a predetermined interval for electrical insulation. When the user slides the finger on the top surface of insulating pad 40, a contact point between conductive films 42 and 43 changes its position, following the wake of the finger-sliding motion. According to the position changes, an output signal obtained through electrode portions 44A to 44D and lead portions 45A to 45D, 46 (i.e., an output voltage value) also varies. The output voltage value is detected from the signals having orthogonal two directions, that is, from the signals occurred between electrode portions 44A and 44B, and from the signals occurred between electrode portions 44C and 44D.

[0036] Now will be discussed in a little more detail how to obtain the output voltage value from touch panel switch 37. On conductive film 43, as shown in Fig. 4, two pairs of electrode portions are arranged in orthogonal orientation. Now, between one pair of electrode portions, 44A and 44B (that is, between lead portions 45A and 45B) and, between the other pair of electrode portions, 44C and 44D (that is, between lead portions 45C and 45D), a voltage is applied alternately, so that conductive film 43 is energized. The depression force

applied to elastic insulating pad 40 recesses conductive film 42, making a contact point with energized conductive film 43. At the same instant, an output voltage value is obtained, between lead portions 45A (45B) and 46, or between lead portions 45C (45D) and 46. Touch panel switch driver 50 shown in Fig. 5 converts the obtained output signal from analog to digital, and sends it to CPU48. Processing the received signal in time sequence, CPU 48 determines in which direction the finger slides, and how fast the finger moves on the surface of touch panel switch 37, thereby moves cursor 55 shown in Fig. 6 according to the direction and speed.

[0037] With cursor 55 pointing a desired item, the user depresses marking 37A down with a depression force of approx. 100 gf. The depression on marking 37A, which validates the selection, activates corresponding switch element of membrane switch 38, so that a decision signal for the selected item is sent to CPU 48. Receiving the decision signal, CPU 48 recognizes the highlighted item by cursor 55 on display 33 inFig. 6. CPU 48 then invokes the corresponding menu data from ROM 52 or ROM 53 and transmits the menu data through LCD driver 49 to display 33. As a result, the user views the desired menu called up on display 33.

[0038] The mechanism will be explained in some detail, taking a case in which the phone number of a called party is searched from pre-stored information as an example. First of all, a user selects the "Calling telephone number" item from the initial menu 54. For this selection, as shown in Fig. 7, with the finger-sliding motion in up-to-bottom direction on touch panel switch 37, the user moves cursor 55 appearing on display 33 to the "Calling telephone number" item. With "Calling telephone number" being highlighted, the user depresses marking 37A for validating the selection. In response to this operation, CPU 48 invokes telephone directory information that is pre-stored in ROM 52 or RAM 53, and sends the information through LCD driver 49 to display 33. Then, with another finger-sliding motion on touch panel switch 37, the user moves cursor 55 to a desired phone number and depresses marking 37A for validating the selection. Receiving this decision signal, CPU 48 recognizes the selection of the desired phone number and performs the predetermined procedures: CPU 48 transmits a transmission signal through transmission-reception circuit 51 and antenna 47 to the selected and validated phone number called party, and makes receiver 32 and transmitter 35 both enable as well.

[0039] In order to place a call, a user may enter a series of numerals indicating a phone number through membrane switch 38 shown in Fig. 2. In this case, an output signal from touch panel switch 37 can be detected, as well as from membrane switch 38. CPU 48 can cope successfully with the situation, executing preprogrammed software, in which any output signal from switch 37 is ignored when membrane switch 38 produces an output signal.

[0040] According to the embodiment, touch panel switch 37 is placed over membrane switch 38 for numerals and symbols entry. The two-layered structure enables not only to maximize the use of an area-limited touch pad surface, but also to reserve the area of display 33 broader. Display 33 can therefore display additional 3-4 lines of information items as compared with the conventional display can. With this structural improvement, it is possible to provide a user-friendly mobile phone with good visual recognition. In addition, on the wide area of touch panel switch 37, changes of an output voltage can be "magnified" to read. In other words, a fine-adjusted control becomes possible. It makes therefore possible to control a moving speed of the operation, as well as a moving direction.

[0041] In selecting-item operation, the moving direction of cursor 55 is not limited to top-to-bottom: in response to the finger-sliding operation in side-to-side or diagonal direction on the touch pad surface of touch panel switch 37, it is possible to control cursor 55 to follow the direction.

[0042] As an application for the embodiment, in selecting-item operation, it is possible to make the items move, with the cursor sitting on a position, instead of moving the cursor on desired item.

[0043] Touch panel switch 37 is not limited to the type described above. As an application of the embodiment, it is effective to employ, for example, a digital type touch panel switch. In this case, an ON-state output signal is produced, following the wake of the finger-sliding operation. The CPU can detect a series of ON-state signals for the evaluation. A static capacitance type touch panel is also available with effect. As another application of the embodiment, the touch panel switch may be made of a transparent material, and an illuminator, such as an electroluminescent (EL) element or a light-emitting diode (LED), may be arranged at the bottom of the touch panel switch. With the help of the illuminator, the user can easily operate the switch even in the dark. As still another application of the embodiment, a normal type switch such as a depression switch with tactile feedback may be employed, instead of using membrane switch 38. In addition, the depression force applied to touch panel switch 37 and membrane switch 38 is not limited to the value mentioned earlier. It may be adjusted to an appropriate value if necessary.

Second Preferred Embodiment

[0044] Fig. 8 is a front view, and Fig. 9 is a cross-sectional view of a mobile phone in accordance with a second preferred embodiment of the present invention. As illustrated in Fig.9, the difference between the structures shown in the first and second embodiments is in the arrangement of entry button member 62, which is inserted between touch panel switch 37 and outer housing 61. The rest of the configuration is the same as that

in the first preferred, embodiment, the description is omitted here.

[0045] On entry button member 62, an array of entry protrusions 62A are formed, each of which penetrates outwardly through each hole 61A perforated in outer housing 61. Each position of protrusions 62A corresponds to the position of each switch element of membrane switch 38. As a user's finger horizontally slides on the face of protrusions 62A one after another, the bottom of entry button member 62 depresses a specified position of the touch panel switch continuously. That is, a staircase-shaped signal is obtained from the touch panel switch. Such a signal is easy to recognize without amplification. It is therefore possible that the moving direction by the finger-sliding operation is easily detected and controlled with high reliability.

[0046] The structure promises an easy-to-view wide display 33 capable of displaying more information, and enhances a detecting accuracy of moving direction and speed in the finger-sliding operation.

[0047] In addition, as described in the first preferred embodiment, the touch panel switch 37 and entry button member 62 may be made of a transparent material, and an illuminator may be employed to light up the top of entry protrusions 62A. With the help of the structure, as is the case in the first preferred embodiment, the user can easily recognize the protrusions 62A in the dark.

Third Preferred Embodiment

[0048] Fig. 10 is a cross-sectional view of a mobile phone in accordance with a third preferred embodiment of the present invention. It is apparent from Fig. 10 that the structure in the embodiment is interchanged the position of the membrane switch and the touch panel switch in the second preferred embodiment. That is, as shown in Fig. 10, elastic membrane switch 71 is laid over touch panel switch 37. Entry button member 62, which has an array of entry protrusions 62A thereon, is inserted between membrane switch 71 and outer housing 61. Each of protrusions 62A is disposed at the position that corresponding to each switch element of membrane switch 71. Each of protrusions 62A, as is the case of the second preferred embodiment, protrudes outwardly through each hole 61A perforated in outer housing 61.

[0049] In the embodiment, when a user depresses any of protrusions 62A, the depression force activates the corresponding switch element of underlying membrane switch 71. On the other hand, when the user slides the finger horizontally on the face of some protrusions 62A, membrane switch 71 can apply a depression force, due to its elasticity, to a series of contact points on touch panel switch 37. Following the wake of the finger-sliding operation, the contact point changes its position on touch panel switch 37. As a result, an output signal corresponding with the position changes is obtained from touch panel switch 37.

[0050] In response to the depression force applied to protrusions 62A, touch panel switch 37 also produces an output signal. As is the case of the first preferred embodiment, for avoiding a malfunction, it is preferable to employ a software-controlled evaluation such that any output signal from switch 37 is ignored when membrane switch 38 produces an output signal.

[0051] A wide space for display 33 is promised, similar to the case of the first preferred embodiment. As another advantage, entry button member 62 not only ensures a positive depression onto membrane switch 71, but also provides the user with a clicking tactile response with ease of use.

[0052] It is possible to configure the entry section without entry button member 62. In this case, membrane switch 71 is placed in exposed arrangement on outer housing 61. This configuration is also effective, as is the case described above.

[0053] The present invention, as described in the embodiments, eliminates a space exclusive to a touch panel switch, configures the touch panel switch and a depression switch with tactile feedback in a two-layered structure. A display area can thus be allocated wide at the entry section. Besides, the two-layered structure realizes an easy and quick selection with reliability by the finger-sliding/depressing operation on the wide touch panel surface. Employing the structure provides an electronic apparatus with greatly improved operability.

Claims

1. An electronic apparatus comprising:

   a display unit which displays a plurality of items and which indicates which of items are selected;
   a depression switch with tactile feedback having a plurality of switch element; and
   a touch panel switch laid over said depression switch with tactile feedback, wherein:

      said touch panel switch is formed to be elastic so that a depression force applied to a surface of said touch panel switch activates said depression switch with tactile feedback; and
      when the surface of said touch panel switch is manipulated with a horizontal sliding depression force, a moving direction and a moving amount of the depression force is determined responsive to changes of an output signal produced by said touch panel switch, thereby an item which corresponds with the moving direction and the moving amount is selected among the plurality of items in said display unit.

2. The electronic apparatus as defined in claim 1, wherein a depression force applied to the surface of said touch panel switch activates said depression switch with tactile feedback, resulting that the selected item is entered.

3. The electronic apparatus as defined in claim 1 or 2, wherein said depression switch with tactile feedback is a membrane switch.

4. The electronic apparatus as defined in claim 1, 2 or 3, wherein a plurality of entry buttons are arranged between said touch panel switch and an outer housing which is laid over said touch panel switch.

5. The electronic apparatus as defined in claim 1, 2 or 3, wherein said touch panel switch is made of a transparent member, and an illuminator disposed at beneath said touch panel switch.

6. The electronic apparatus as defined in claim 4, wherein said touch panel switch and the entry buttons are made of the transparent member, and the illuminator disposed at beneath said touch panel switch.

7. An electronic apparatus comprising:

a display unit which displays a plurality of items and which indicates which of items are selected;
a membrane switch with tactile feedback formed to be elastic, having a plurality of switch element; and
a touch panel switch laid beneath said membrane switch with tactile feedback, wherein:

when a sliding depression force on a surface of said membrane switch activates said touch panel switch via said membrane switch; and
a moving direction and a moving amount of the depression force is determined responsive to a change of an output signal produced by said touch panel switch, thereby an item which corresponds with the moving direction and the moving amount is selected among the plurality of items in said display unit.

8. The electronic apparatus as defined in claim 7, wherein a plurality of entry buttons are arranged between said membrane switch and an outer housing which is laid over said membrane switch.

FIG. 1

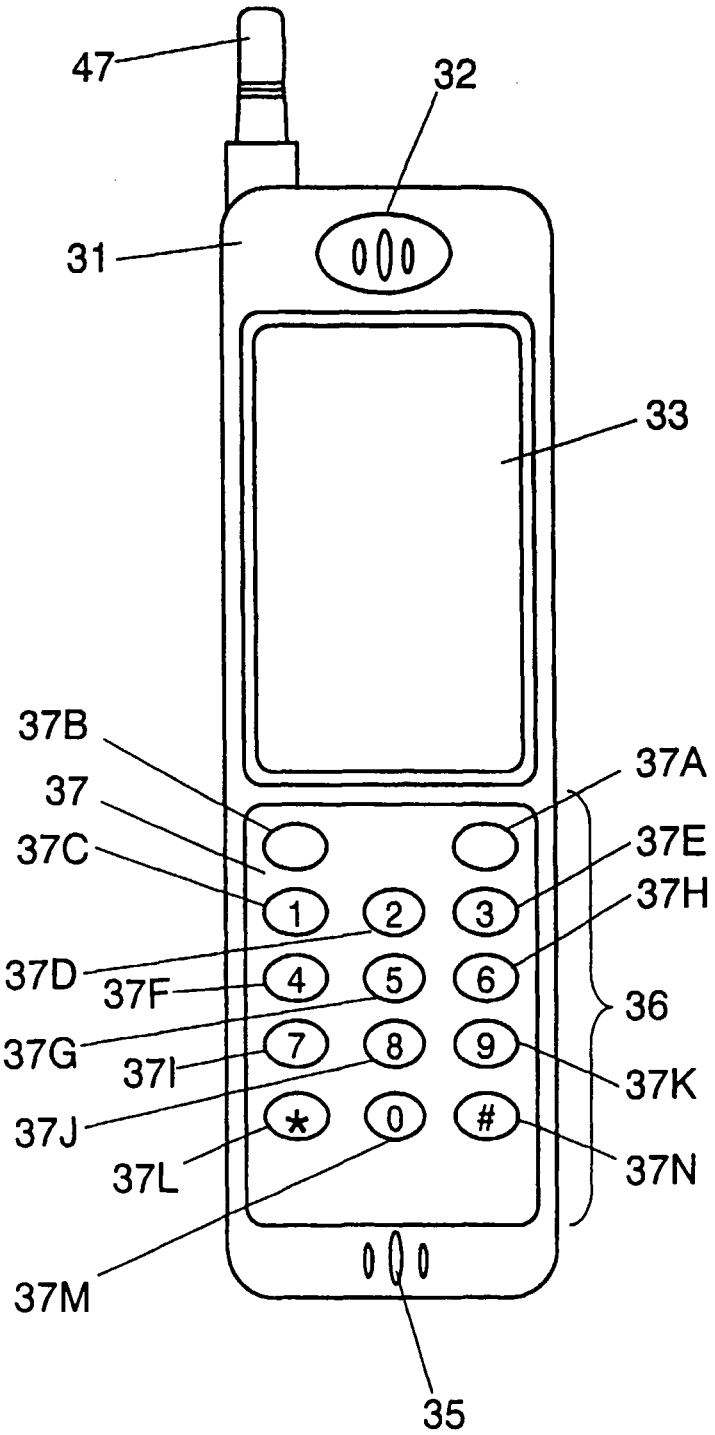

FIG. 2

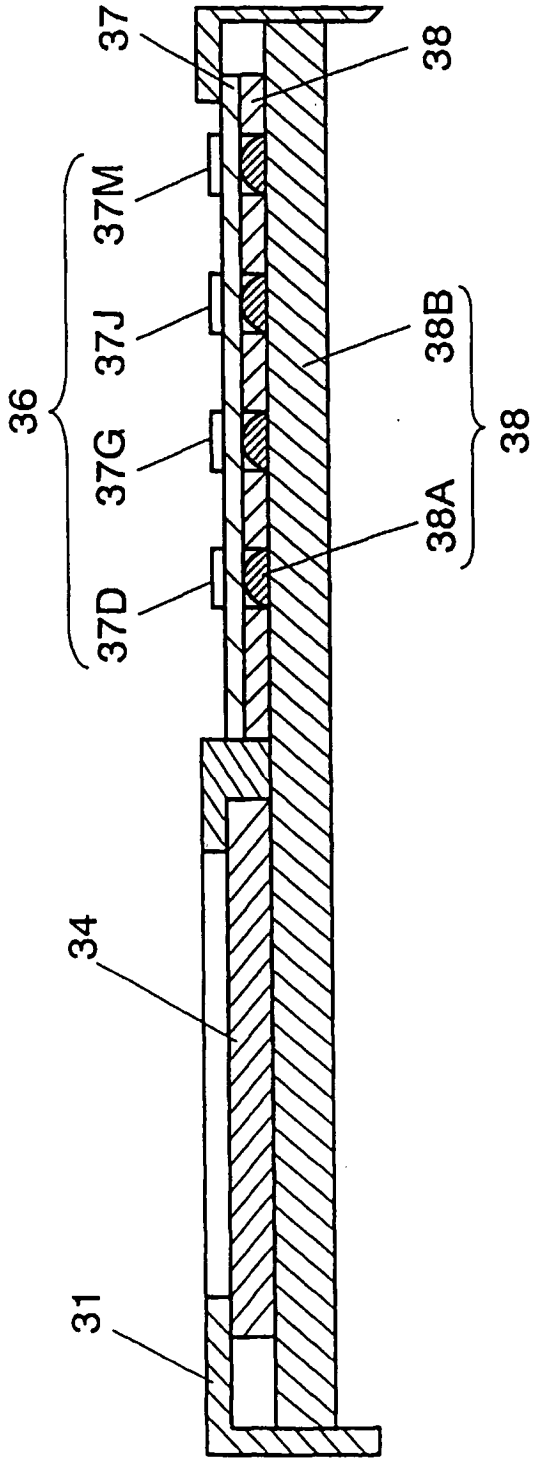

FIG. 3

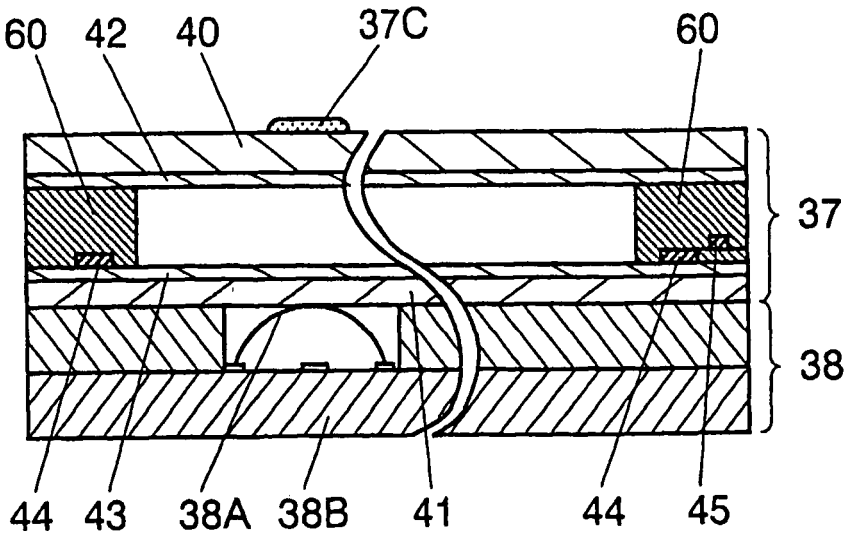
60
42
40
37C
60
37
38
44
43
38A
38B
41
44
45

FIG. 4

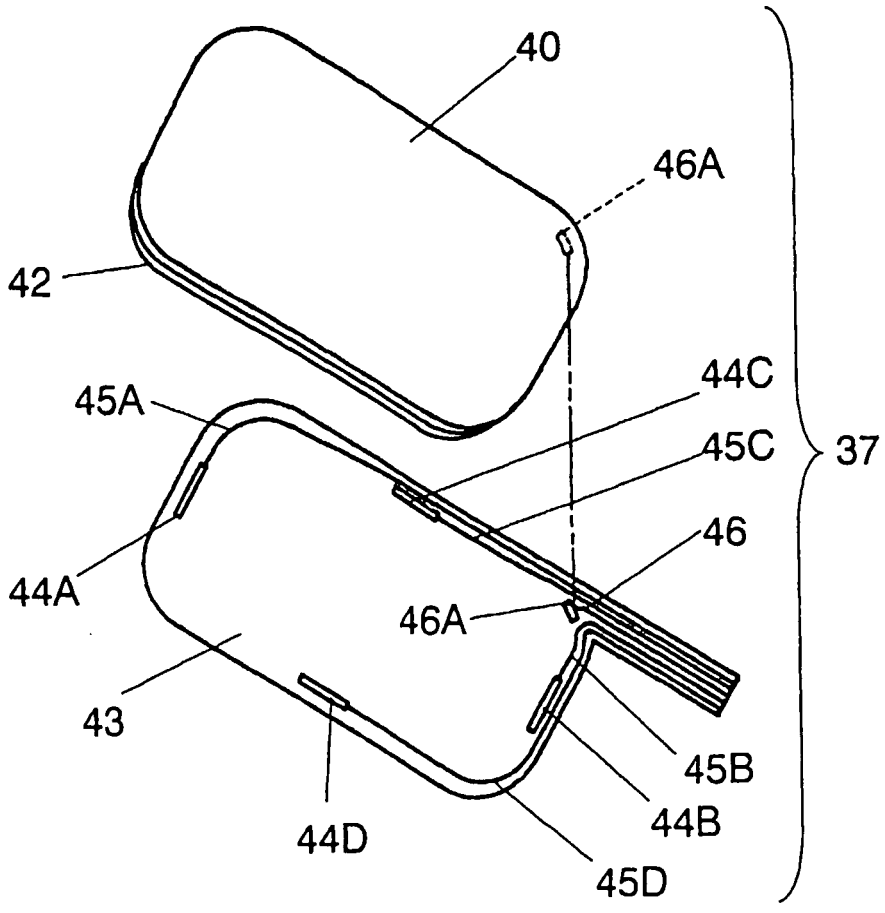
40
46A
42
44C
45A
45C
37
46
44A
46A
43
45B
44B
44D
45D

FIG. 5

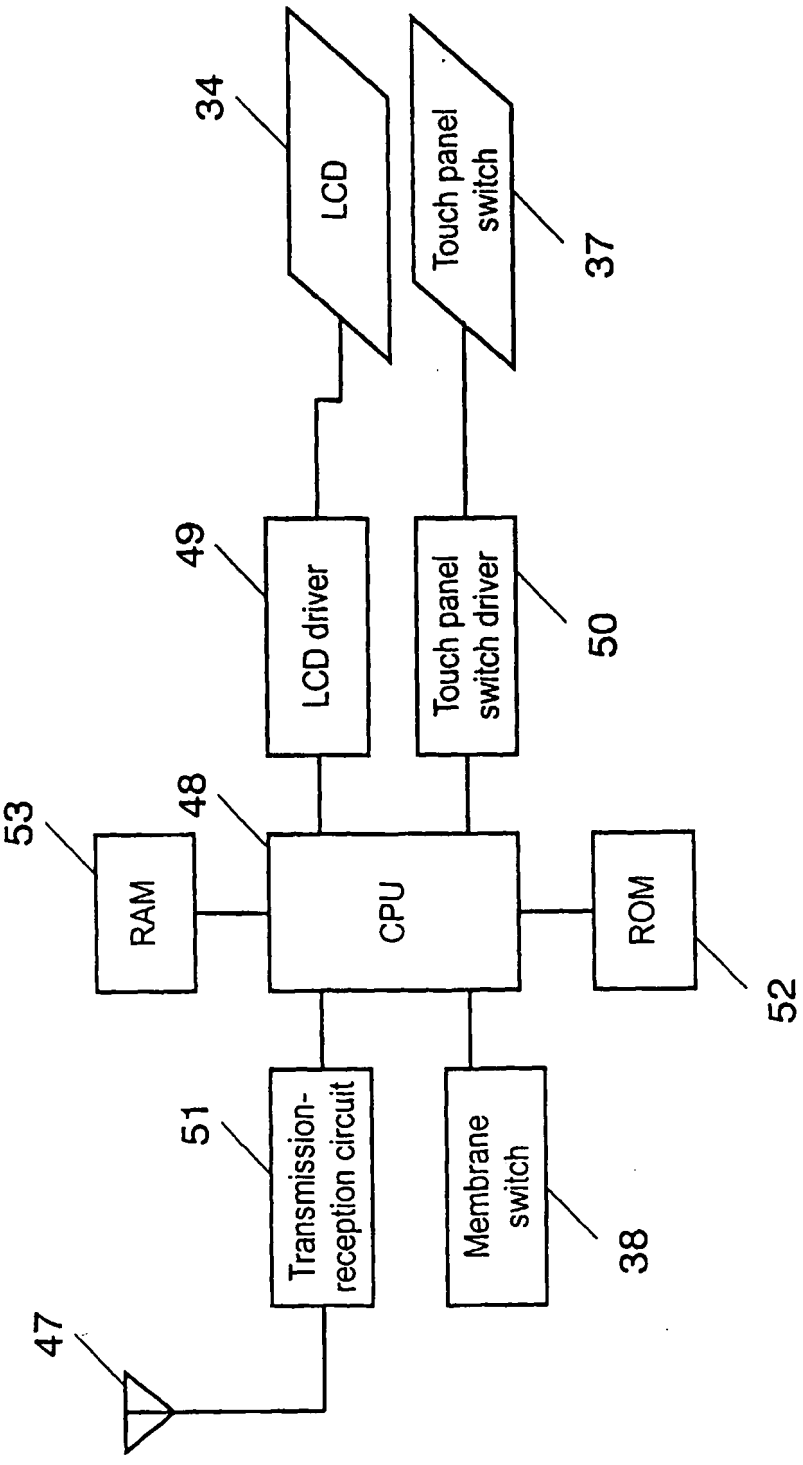
34
LCD
Touch panel switch
37
49
LCD driver
Touch panel switch driver
50
53
48
RAM
CPU
ROM
52
51
Transmission-reception circuit
Membrane switch
38
47

FIG. 6

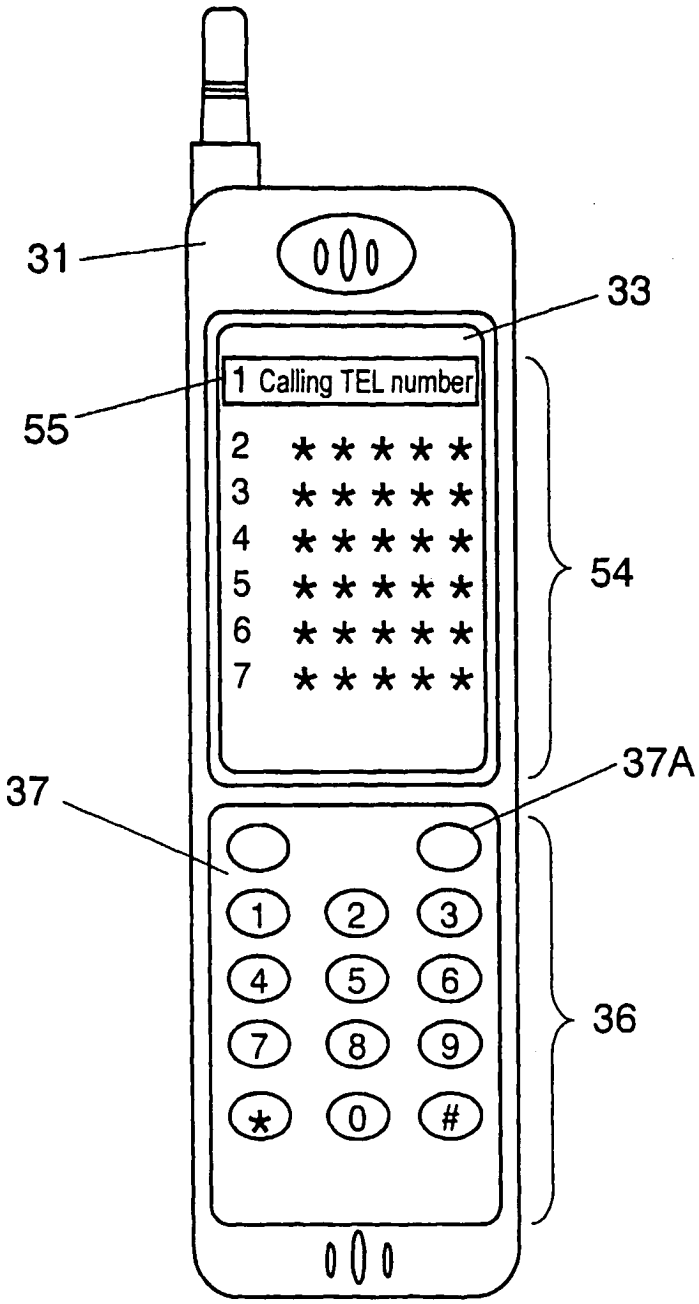

FIG. 7

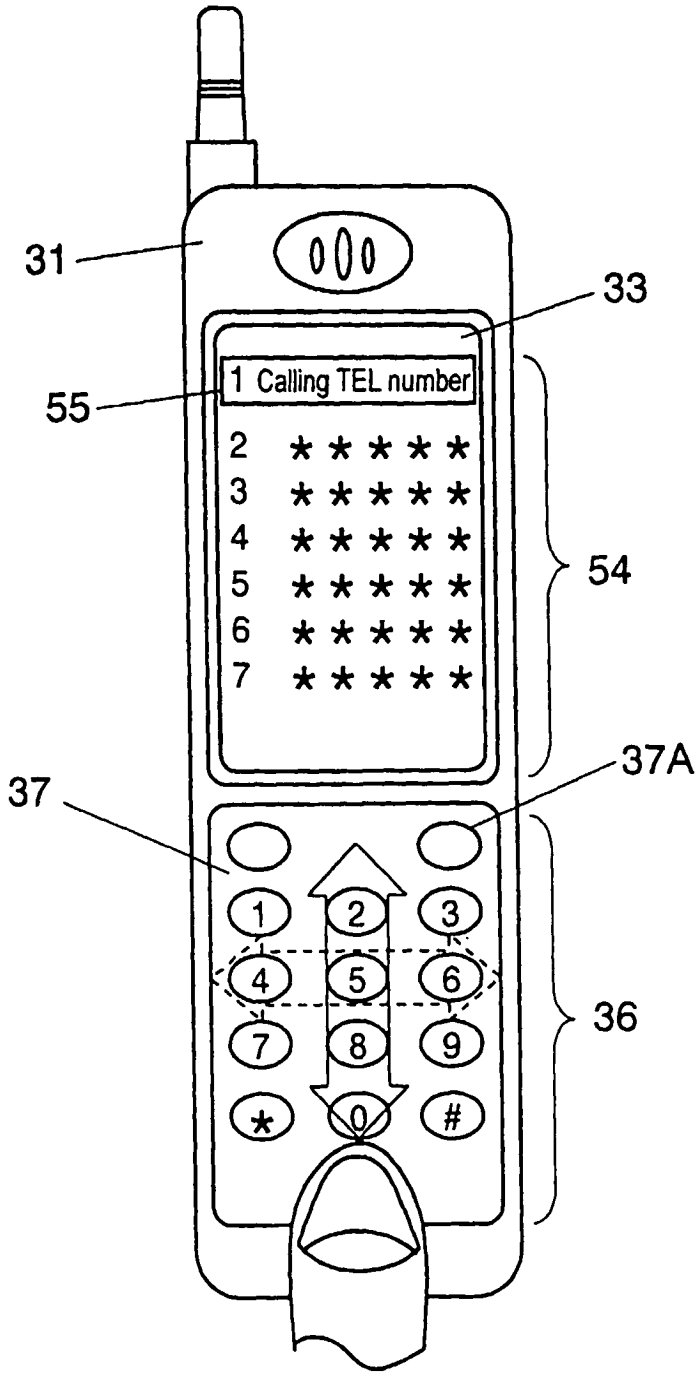

FIG. 8

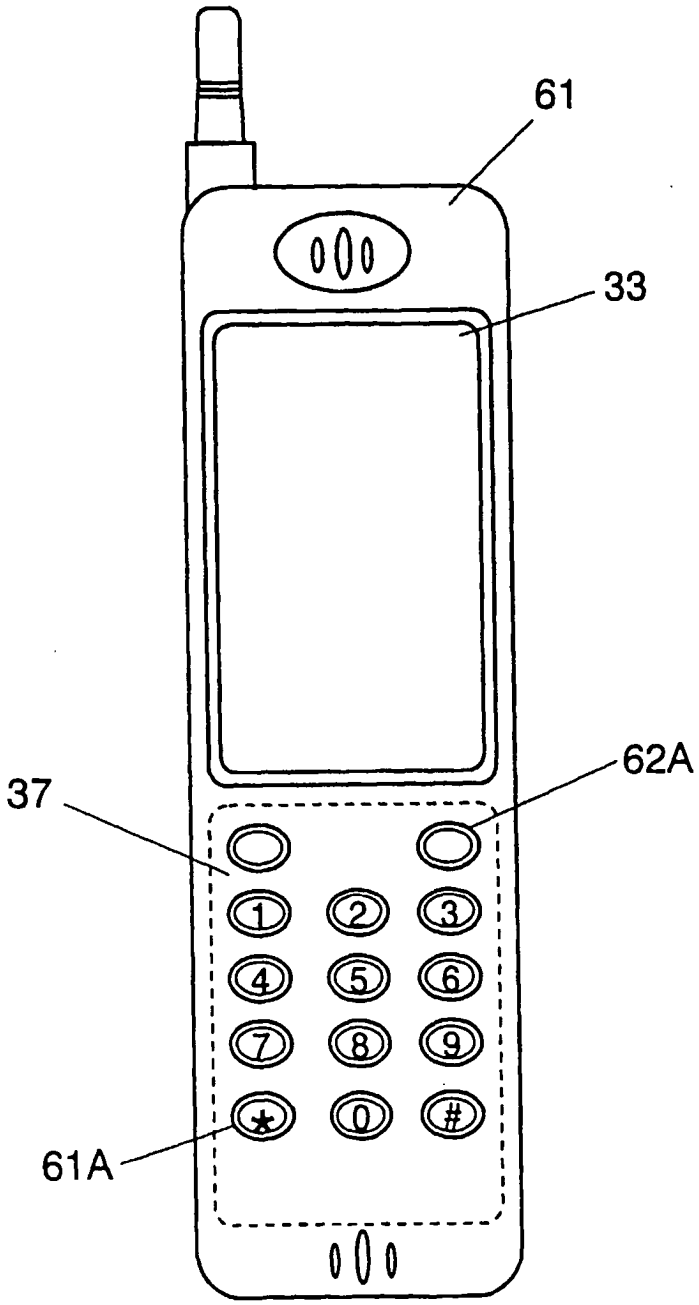

FIG. 9

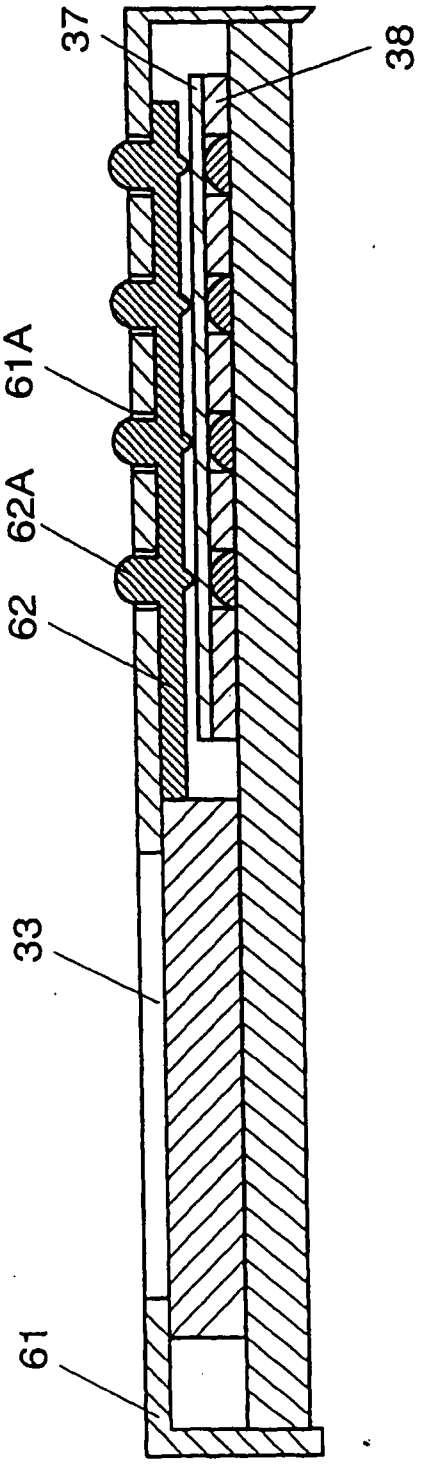

FIG. 10

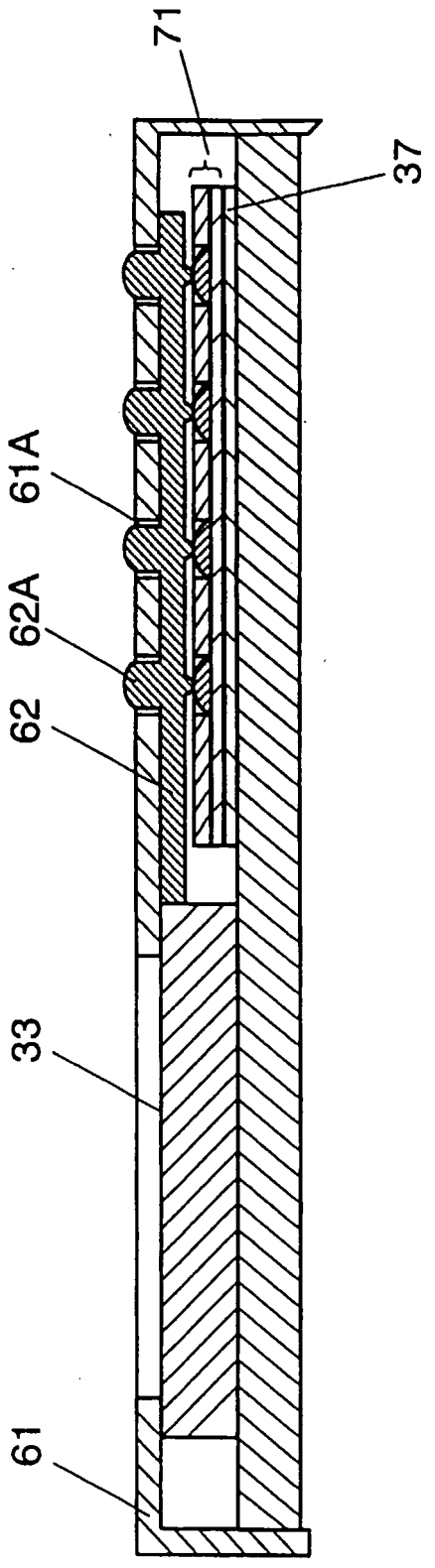

FIG. 11 PRIOR ART

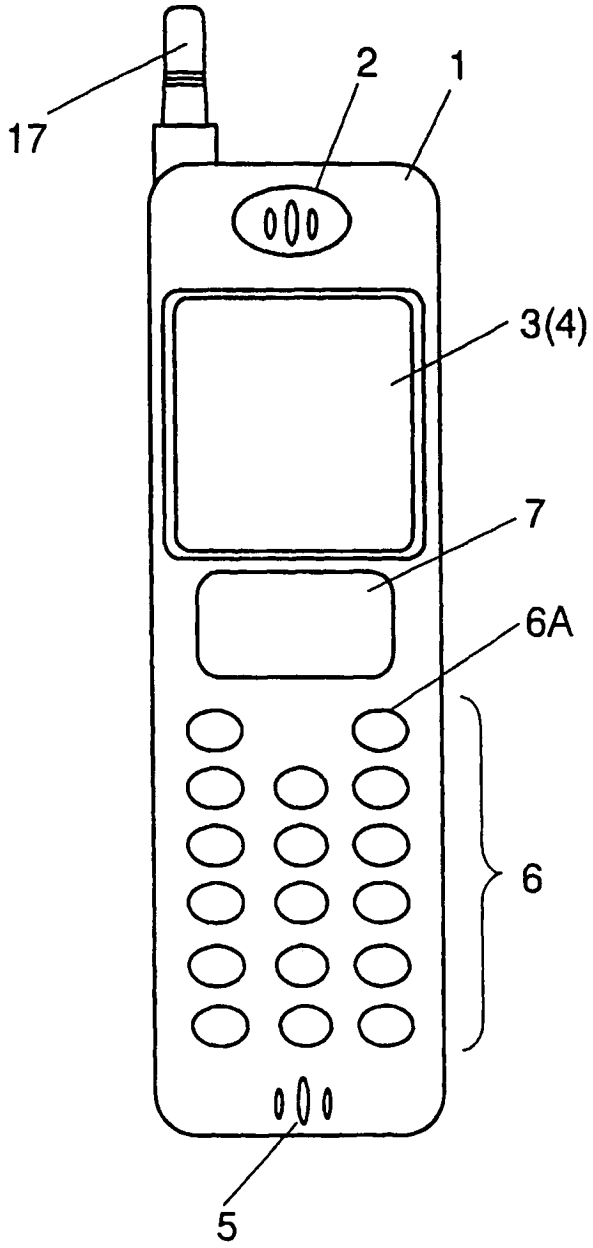

FIG. 12 PRIOR ART

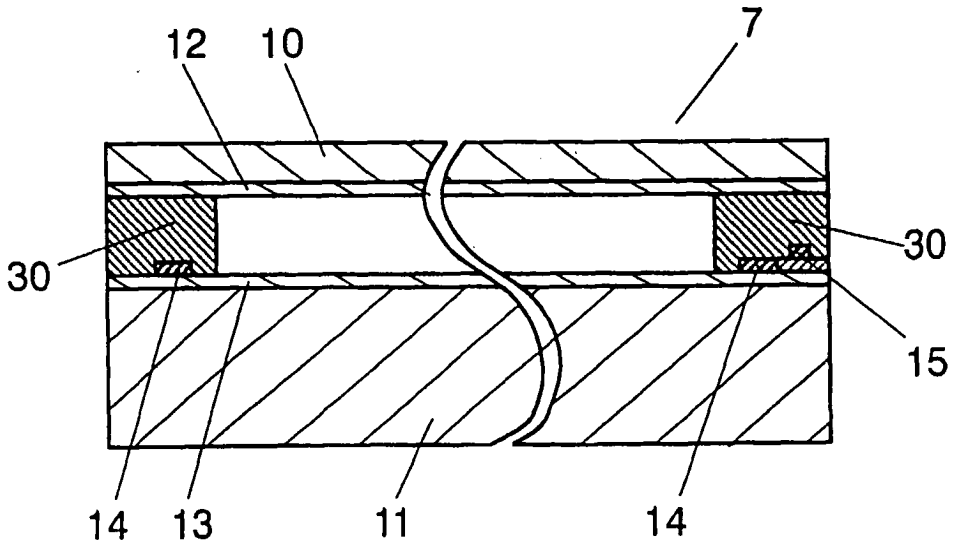

FIG. 13 PRIOR ART

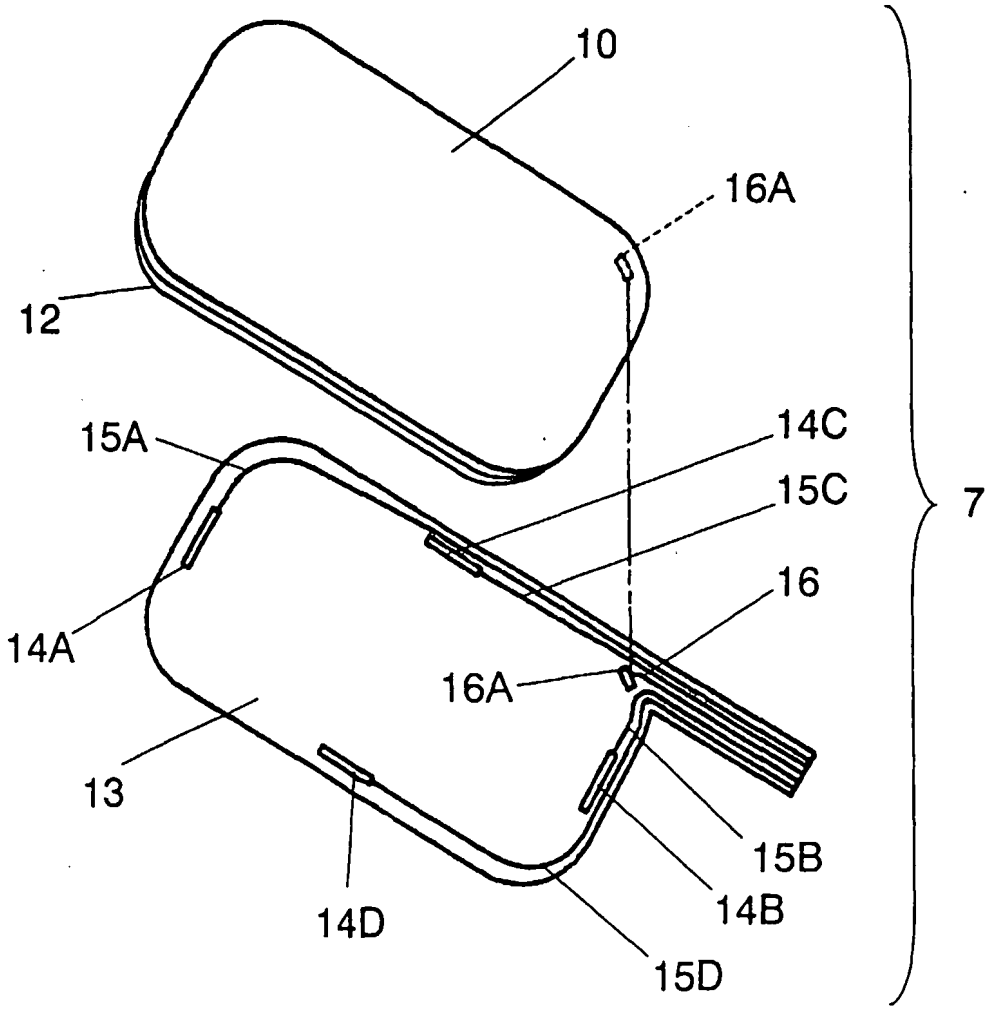

FIG. 14 PRIOR ART

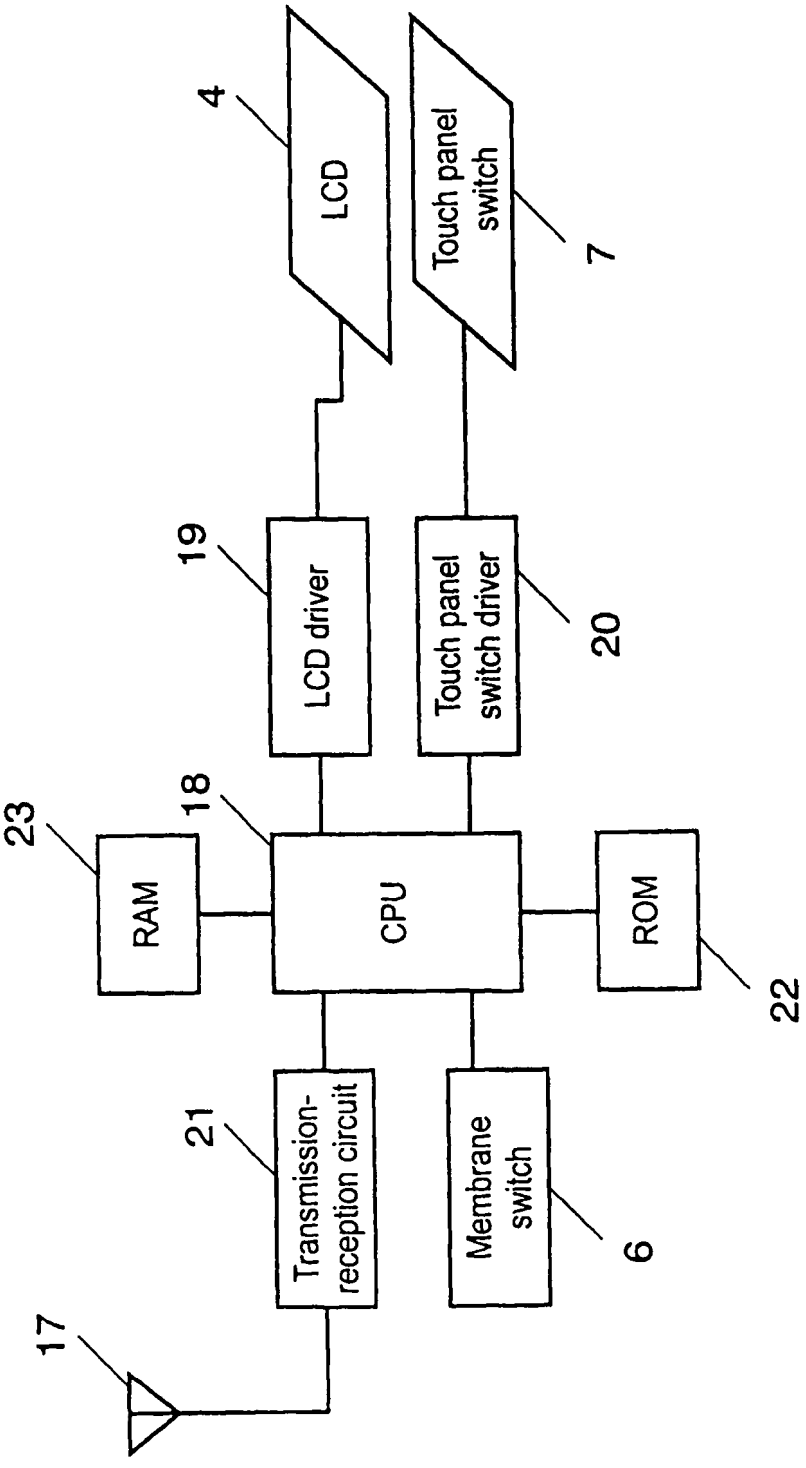

FIG. 15 PRIOR ART

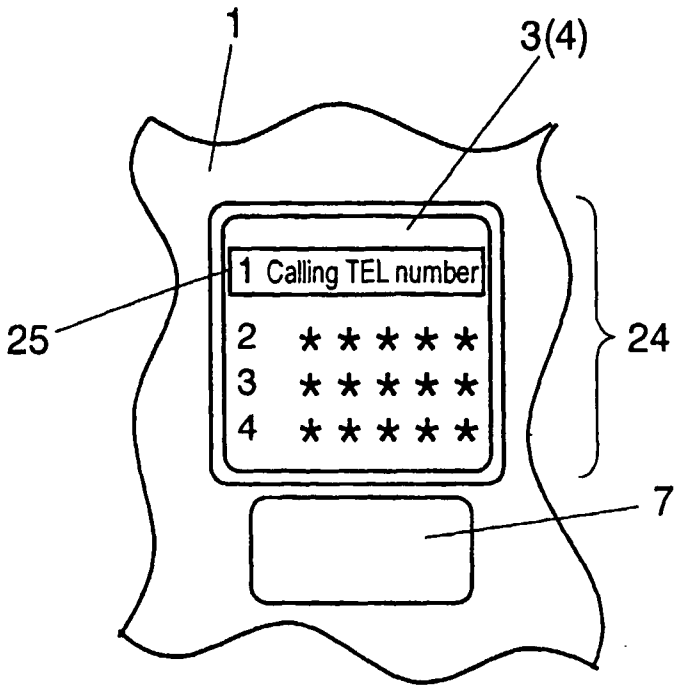

FIG. 16 PRIOR ART